AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in this application.

Listing of Claims:

Claim 1 (Currently Amended): A method of operating an actuatable well tool, the method comprising the steps of:

placing the tool in a subterranean well bore;

providing a receiver operable to detect electromagnetic waves propagated through the earth and having a circuit board portion with a main CPU portion adapted to receive an electromagnetic wave detection signal and a ground signal and responsively generate an actuation request signal, and an auxiliary fail-safe CPU portion operative to receive the actuation request signal, monitor selected parameters of the tool to detect whether system errors exist, and responsively generate an actuation signal only in the absence of sensed system errors;

propagating electromagnetic waves through the earth;

detecting the electromagnetic waves; and

actuating the tool in response to the detection of the electromagnetic waves and generation of the actuation signal.

Claim 2 (Original): The method of Claim 1 wherein:

the placing step is performed by lowering the tool into the wellbore on a tubing structure.

Claim 3 (Original): The method of Claim 1 wherein:

the placing step is performed by placing a mechanically actuatable well tool in the wellbore.

Claim 4 (Original): The method of Claim 1 wherein:

the placing step is performed by placing a perforating gun in the wellbore.

Claim 5 (Original): The method of Claim 4 wherein:

the placing step is performed by placing a mechanically actuatable perforating gun in the wellbore.

Claim 6 (Original): The method of Claim 1 wherein:

the propagating step is performed by propagating electromagnetic waves having square configurations through the earth.

Claim 7 (Original): The method of Claim 6 wherein:

the propagating step is performed by propagating electromagnetic waves having modulated square configurations through the earth.

Claim 8 (Original): The method of Claim 1 wherein:

the propagating step is performed by propagating electromagnetic waves having a frequency of approximately 15 Hz or less through the earth.

Claim 9 (Original): The method of Claim 1 further comprising the step of:

encoding an actuation address in the electromagnetic waves.

Claim 10 (Currently Amended): A method of operating an actuatable well tool, the method comprising the steps of:

providing a sensor for sensing a predetermined downhole parameter;

providing a well tool assembly including the well tool, an electromagnetic frequency receiver, ~~and~~ an actuation section, and a transmitter operative to transmit through the earth to a surface-disposed receiver electromagnetic waves indicative of the value of the sensed parameter;

lowering the well tool assembly into a subterranean wellbore;

propagating electromagnetic waves through a portion of the earth externally adjacent the wellbore; and

utilizing the receiver to detect the electromagnetic waves in the earth and responsively cause the actuation section to actuate the well tool.

Claim 11 (Original): The method of Claim 10 wherein:

the well tool is a mechanically actuatable well tool.

Claim 12 (Original): The method of Claim 11 wherein:

the mechanically actuatable well tool is a perforating gun.

Claim 13 (Original): The method of Claim 10 wherein:

the lowering step is performed by securing the well tool assembly to a tubing structure and then lowering the tubing structure into the wellbore.

Claim 14 (Original): ~~The method of~~ Claim 10 wherein:

the propagating step is performed by propagating electromagnetic waves having square configurations through the earth.

Claim 15 (Original): The method of Claim 10 wherein:

the propagating step is performed by propagating electromagnetic waves having sine or cosine configurations through the earth.

Claim 16 (Original): The method of Claim 10 wherein:

the propagating step is performed by propagating electromagnetic waves having a frequency of approximately 15 Hz or less through the earth.

Claim 17 (Original): The method of Claim 10 further comprising the step of:

encoding an actuation address in the electromagnetic waves.

Claims 18-23 (Canceled)

Claim ~~24~~ 18 ~~(Currently Amended): A subterranean well~~ comprising:

a wellbore extending through the earth; and

a well tool assembly disposed in the wellbore and including:

an actuatable well tool,

a receiver operable to detect electromagnetic waves propagated through the earth and responsively generate a signal, the receiver having a circuit board portion with a main CPU portion adapted to receive an electromagnetic wave detection signal and a ground signal and responsively generate an actuation request signal, and an auxiliary fail-safe CPU portion operative to receive the actuation request signal, monitor selected parameters of the well tool assembly to detect whether system errors exist, and responsively generate the first-mentioned signal only in the absence of sensed system errors, and

an actuation structure operable to receive the first-mentioned signal and responsively actuate the tool.

Claim ~~25~~ 19 (Original): The subterranean well of Claim ~~24~~ 18 wherein:

the actuatable well tool is a mechanically actuatable well tool.

Claim ~~26~~ 20 (Original): The subterranean well of Claim ~~25~~ 19 wherein:

the mechanically actuatable well tool is a perforating gun having a mechanically actuatable firing head portion.

Claim ~~27~~ 21 (Original): The subterranean well of Claim ~~25~~ 19 wherein:

the actuation structure includes a motor operative to mechanically actuate the well tool.

Claim 28 (Original): The subterranean well of Claim 27 wherein:

the motor has an output member translatable in a selectively variable direction through a selectively adjustable stroke.

Claim 29 (Original): The subterranean well of claim 24 further comprising:

a transmitter operative to propagate electromagnetic waves through a portion of the earth externally adjacent the wellbore.

Claim 30 (Original): The subterranean well of Claim 29 wherein:

the electromagnetic waves have square configurations.

Claim 31 (Original): The subterranean well of Claim 30 wherein:

the electromagnetic waves are modulated square waves.

Claim 32 (Original): The subterranean well of Claim 29 wherein:

the electromagnetic waves have a frequency of approximately 15 Hz or less.

Claim 33 (Original): The subterranean well of Claim 29 wherein:

the electromagnetic waves have an actuation address encoded therein.

Claim 34 (Original): The subterranean well of Claim 24 wherein:

the receiver is operable to generate the signal in response to detecting electromagnetic waves propagated through the earth and having both a predetermined frequency and encoded actuation address.

Claim ~~35~~ 30 (Currently Amended): ~~The subterranean well of Claim 24 wherein:~~ A subterranean well comprising:

a wellbore extending through the earth; and

a well tool assembly disposed in the wellbore and including:

an actuatable well tool,

a receiver operable to detect electromagnetic waves propagated through the earth and responsively generate a signal, and

an actuation structure operable to receive the signal and responsively actuate the tool,

the wellbore ~~is~~ being lined with a metal casing having a first portion, and a second portion longitudinally spaced apart from the first portion in a downhole direction,

the receiver ~~has~~ having a control circuitry portion, and

the well tool assembly ~~has~~ having first and second electrically conductive paths which are insulatively isolated from one another and are respectively operative to (1) transmit an electromagnetic wave signal from the first casing portion to the control circuitry portion, and (2) connect a ground reference from the second casing portion to the control circuitry portion.

Claim ~~36~~ 31 (Original):The subterranean well of Claim ~~35~~ 30 wherein:

the well tool assembly has an elongated, electrically conductive tubular outer body portion and a generally coaxially extending electrically conductive tubular inner body portion, each of the outer and inner body portions having insulative gaps formed therein between adjacent longitudinal sections thereof.

Claim ~~37~~ (Original): The subterranean well of Claim ~~36~~ wherein:

the adjacent longitudinal sections of the tubular outer body portion having axially spaced apart threaded end portions threadedly connected to an annular collar member at thread joints containing an electrically insulative material defining spaced apart insulation gaps between the longitudinal sections of the outer body portions and electrically isolating them from one-another.

Claim 38 (Canceled)

Claim ~~39~~ (Amended) ~~The subterranean well of Claim 24 wherein:~~ A subterranean well comprising:

a wellbore extending through the earth; and

a well tool assembly disposed in the wellbore and including:

an actuatable well tool,

a receiver operable to detect electromagnetic waves propagated through the earth and responsively generate a signal, and

an actuation structure operable to receive the signal and responsively actuate the tool,

the subterranean well further ~~comprises~~ comprising a sensor for sensing a predetermined downhole parameter, and

the well tool assembly further ~~includes~~ including a transmitter operative to transmit through the earth to a surface-disposed receiver electromagnetic waves indicative of the value of the sensed parameter.

Claim ~~40~~ (Original): The subterranean well of Claim ~~24~~ wherein:

the well tool assembly is suspended on a tubing structure extending into the wellbore.

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Claim 41 (Currently Amended): A well tool assembly operatively positionable in a subterranean wellbore and comprising:

an actuatable well tool;

a receiver operable to detect electromagnetic waves propagated through the earth and responsively generate a signal, the receiver having a circuit board portion with a main CPU portion adapted to receive an electromagnetic wave detection signal and a ground signal and responsively generate an actuation request signal, and an auxiliary fail-safe CPU portion operative to receive the actuation request signal, monitor selected parameters of the well tool assembly to detect whether system errors exist, and responsively generate the first-mentioned signal only in the absence of sensed system errors; and

an actuation structure operative to receive the first-mentioned signal and responsively actuate the tool.

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Claim 42 (Original): The well tool assembly of Claim 41 wherein:

the actuatable well tool is a mechanically actuatable well tool.

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Claim 43 (Original): The well tool assembly of Claim 42 wherein:

the mechanically actuatable well tool is a perforating gun having a mechanically actuatable firing head portion.

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Claim 44 (Original): The well tool assembly of Claim 42 wherein:

the actuation structure includes a motor operative to mechanically actuate the well tool.

Claim 45 (Original): The well tool assembly of claim 44 wherein:

the motor has an output member translatable in a selectively variable direction through a selectively adjustable stroke.

Claim 46 (Original): The well tool assembly of Claim 44 wherein:

the receiver is operable to generate the signal in response to detecting electromagnetic waves propagated through the earth and having both a predetermined frequency and encoded actuation address.

Claim 47 (Currently Amended): ~~The well tool assembly of Claim 41 wherein:~~ A well tool assembly operatively positionable in a subterranean wellbore and comprising:

an actuatable well tool;

a receiver operable to detect electromagnetic waves propagated through the earth and responsively generate a signal; and

an actuation structure operative to receive the signal and responsively actuate the tool,

the receiver ~~has~~ having a control circuitry portion, and

the well tool assembly ~~has~~ having first and second electrically conductive paths which are insulatively isolated from another and are respectively operative to (1) transmit a received electromagnetic wave signal to the control circuitry portion, and (2) transmit a received ground signal to the control circuitry portion.

Claim 48 (Original): The well tool assembly of Claim 47 wherein:

the well tool assembly has an elongated, electrically conductive tubular outer body portion and a generally coaxially extending electrically conductive tubular inner body portion, each of the outer and inner body portions having insulative gaps formed therein between adjacent longitudinal sections thereof.

Claim 49 (Original): The well tool assembly of Claim 48 wherein:

the adjacent longitudinal sections of the tubular outer body portion having axially spaced apart threaded end portions threadedly connected to an annular collar member at thread joints containing an electrically insulative material defining spaced apart insulation gaps between the longitudinal sections of the outer body portions and electrically isolating them from one another.

Claim 50 (Canceled)

Claim 51 (Currently Amended): ~~The well tool assembly of Claim 41 further comprising:~~ A well tool assembly operatively positionable in a subterranean wellbore and comprising:

an actuatable well tool;

a receiver operable to detect electromagnetic waves propagated through the earth and responsively generate a signal;

an actuation structure operative to receive the signal and responsively actuate the tool;

a sensor for sensing a predetermined downhole parameter; and

a transmitter operative to generate electromagnetic waves indicative of the value of the sensed parameter.

Claim 52 (Canceled)

Claim 53 (Currently Amended): ~~The perforating gun assembly of claim 52 further comprising:~~ A perforating gun assembly operatively positionable in a subterranean wellbore and comprising:

a perforating gun having a mechanically actuatable firing head portion;

an actuating section connected to the firing head and including a motor operable to engage and mechanically actuate the firing head portion;

a receiver connected to the actuating section and being operative to detect electromagnetic waves propagated through the earth and responsively operate the motor; and

a sensor operative to sense a downhole parameter; and

a transmitter operative to transmit electromagnetic waves indicative of the value of the sensed downhole parameter.

Claim 54 (Currently Amended): A method of perforating a subterranean wellbore casing, the method comprising the steps of:

lowering spaced apart perforating gun assemblies through the wellbore to a portion of the casing to be perforated, each perforating gun assembly including a perforating gun having a mechanically actuatable firing head, a motor control section connected to the firing head, and an electromagnetic frequency receiver connected to the motor control section, each receiver having a circuit board portion with a main CPU portion adapted to receive an electromagnetic wave detection signal and a ground signal and responsively generate an actuation request signal, and an auxiliary fail-safe CPU portion operative to receive the actuation

request signal, monitor selected parameters of the associated perforating gun assembly to detect whether system errors exist, and responsively generate a firing signal only in the absence of sensed system errors;

propagating electromagnetic waves through a portion of the earth externally adjacent the casing; and

utilizing the receivers to detect the electromagnetic waves and sequentially fire the perforating guns in a preselected order.

Claim 56 (Currently Amended): For use in a subterranean wellbore, a method of operating a plurality of well tool assemblies, the method comprising the steps of:

lowering spaced apart well tool assemblies through the wellbore to a predetermined portion of the wellbore, each well tool assembly including a mechanically actuatable well tool, a motor section connected to the well tool, and an electromagnetic frequency receiver connected to the motor section;

propagating electromagnetic waves through a portion of the earth externally adjacent the casing; and

utilizing the receivers to detect the electromagnetic waves and sequentially actuate the well tools in a preselected order;

providing a sensor operative to sense a predetermined downhole parameter; and

providing a transmitter operative to transmit through the earth to a surface-disposed receiver electromagnetic waves indicative of the value of the sensed parameter.

Sub B1 62 **Claim 56** (Currently Amended): A subterranean well comprising:

a wellbore extending through the earth; and

a spaced apart plurality of well tool assemblies disposed in the wellbore and being selectively actuatable in a predetermined sequence, each well tool assembly including an actuatable well tool, a receiver operable to detect electromagnetic waves propagated through the earth and responsively generate a signal , and an actuation structure operable to receive the signal and responsively actuate the tool, the receiver having a circuit board portion with a main CPU portion adapted to receive an electromagnetic wave detection signal and a ground signal and responsively generate an actuation request signal, and an auxiliary fail-safe CPU portion operative to receive the actuation request signal, monitor selected parameters of the well tool assembly to detect whether system errors exist, and responsively generate the first-mentioned signal only in the absence of sensed system errors.

a5 63 62 **Claim 57** (Original): The subterranean well of Claim 56 wherein:

the well tools are mechanically actuatable.

64 62 **Claim 58** (Original) The subterranean well of Claim 56 wherein:

at least one of the well tools is a perforating gun.

65 62 **Claim 59** (Original): The subterranean well of Claim 56 wherein at least one of the well tools is a mechanically actuatable perforating gun.

a6 Sub B1 24 33 **Claim 60** (New) The subterranean well of Claim 39 wherein:

the actuatable well tool is a mechanically actuatable well tool.

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Claim 61 (New): The subterranean well of claim 60 wherein:

the mechanically actuatable well tool is a perforating gun having a mechanically actuatable firing head portion.

Claim 62 (New) The subterranean well of Claim 60 wherein:

the actuation structure includes a motor operative to mechanically actuate the well tool.

Claim 63 (New): The subterranean well of Claim 62 wherein:

the motor has an output member translatable in a selectively variable direction through a selectively adjustable stroke.

Claim 64 (New): The subterranean well of claim 39 further comprising:

a transmitter operative to propagate electromagnetic waves through a portion of the earth externally adjacent the wellbore.

Claim 65 (New) The subterranean well of Claim 64 wherein:

the electromagnetic waves have square configurations.

Claim 66 (New): The subterranean well of Claim 65 wherein:

the electromagnetic waves are modulated square waves.

Claim 67 (New): The subterranean well of Claim 64 wherein:

the electromagnetic waves have a frequency of approximately 15 Hz or less.

Claim 68 (New): The subterranean well of Claim 64 wherein:

the electromagnetic waves have an actuation address encoded therein.

Claim 69 (New): The subterranean well of Claim 30 wherein:

the receiver is operable to generate the signal in response to detecting electromagnetic waves propagated through the earth and having both a predetermined frequency and encoded actuation address.

Claim 70 (New) The well tool assembly of Claim 51 wherein:

the actuatable well tool is a mechanically actuatable well tool.

Claim 71 (New): The well tool assembly of Claim 70 wherein:

the mechanically actuatable well tool is a perforating gun having a mechanically actuatable firing head portion.

Claim 72 (New): The well tool assembly of Claim 70 wherein:

the actuation structure includes a motor operative to mechanically actuate the well tool.

Claim 73 (New): The well tool assembly of claim 72 wherein:

the motor has an output member translatable in a selectively variable direction through a selectively adjustable stroke.

Claim 74 (New): The well tool assembly of Claim 51 wherein:

the receiver is operable to generate the signal in response to detecting electromagnetic waves propagated through the earth and having both a predetermined frequency and encoded actuation address.